Design and Test of Submersible Umbrella & Underwater Maintenance Complex Node Cover

Yanghou Chen and Guoming Chen
Centre for Offshore Engineering and Safety Technology, China University of Petroleum
Dongying, Shandong, P. R. China

ABSTRACT
Detection and maintenance of offshore structures under sea water are difficult to implement especially in the ChenDao Oil Field Yellow River Delta. This article presents several equipments to make detects and maintains easily to be actualized. A shallow water submersible umbrella is introduced to check the scour of piles and damnification of production lines which is not easily closed up. An underwater maintenance complex node cover of offshore platform is developed for dry welding under sea water. The feasibility of two new auxiliary equipments is tested by small size model. The results of experimentation show that the assumption of partial water insulation around work area by uninterrupted air input is reasonable. And theoretic analysis is given.

KEY WORDS: dry welding; wet welding; complex joint; repair; maintenance.

INTRODUCTION
Most of offshore structures for oil exploitation are composed of components which are framed by welding many steel elements. Though it can change microstructure around welding zone, welding is the best effective maintenance technology of ordinary steel structure. It is the normal method for effecting subsea weld repairs and has been used as an underwater maintenance technique since about 1970. Wet welding also can repair underwater structures, but the quality of repaired elements is not good as dry welding. So dry welding is preferred to wet welding in many conditions. A lot of equipments are developed for underwater dry welding. Dry welding can be implemented in one atmosphere or high pressure above one atmosphere under sea water. Two methods are available which can provide a dry environment at the repair site underwater. The one is cofferdam, the other is pressure-resistant chamber. But one-atmosphere environment repair methods are uneconomic for depths greater than 10 meters because of sealing and amount of steelwork. Cofferdam attracts more environmental forces and it is heavy even for smaller depths. The high pressure welding is put in practice by using lightweight steel habitats, inflatable flexible habitats, mini habitats, portable dry spot habitats and so on. It may not be feasible to use an ordinary habitat around a complex joint because of the complexity of fitting and sealing the habitat around each members of joint. It is also difficult to install the ordinary habitat in shallow water because of wave and current forces. The more complicated the joint is, the more time expended on cofferdam or habitait's use.

Defects detection underwater is not easy implement especially in the ChenDao Oil Field Yellow River Delta where visibility is more low. Some faults under water are difficult to inspect. Lots of apparatuses are developed to work in the feculent sea water by China University of Petroleum (East China), such as Alternating Current Field Measurement (ACFM), replacement of feculent water with clear water, and so on.

DESIGN OF SUBMERSIBLE UMBRELLA
The purpose of submersible umbrella and underwater maintenance complex node cover design is providing a water-free space in which detecting personnel can work near the testing structures. The shallow water submersible umbrella is composed of canvas umbrella, stationary ring, boom davit, encapsulated tool box, lower counter weight, steel plate net floor and so on.

![Fig. 1 Assembly Drawing of Submersible Umbrella](image)

Figure 1 is the assembly drawing of submersible umbrella. Canvas